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In order to investigate the effect of reinforcement on learning, 21 disadvantaged black children, 4 to 5 years of age, were divided among three treatment groups. Group I children received only feedback (information) as to the correctness or incorrectness of their responses. Group II children received a raisin for each correct response, and group III children received only some form of verbal reinforcement. The task involved answering questions relating to a story by touching a dot located under each response choice with a water pen. The dot was chemically treated to turn either green (correct answer) or red (incorrect answer). Each child was administered a pretest and a posttest (identical tests) over the vocabulary introduced in the story. Each child was subsequently given a new learning situation in which the same type of response was required, but to a slightly different task. The data indicated that although the raisin reward appeared to be a more potent reinforcer, the children learned to use feedback to correct erroneous responses and used it in new learning situations. In fact, tangible and verbal rewards ma y produce emotional side effects disruptive to learning. (WD)

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CONDITIONS FOSTERING THE USE OF INFORMATIVE FEEDBACK BY YOUNG CHILDREN[1]

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Introduction

The level of language ability of the preschool disadvantaged child has become a major concern among research workers and educators. The question no longer is whether or not impoverishment is present, the research evidence is quite conclusive on this point, but rather focuses on how to develop and implement educational programs which will lessen the deficit.

There are currently in progress a number of research studies testing the comparative effectiveness of different intervention procedures. The impact of such programs is appreciably affected by variables which are only too often neglected in the evaluation. One of the most important of these is the area of motivation, that is, getting learners to want to do well on school tasks. This is especially critical in the planning of intervention programs for disadvantaged children.

For a long time it was accepted as almost axiomatic that any type of positive reinforcement would be more effective in changing behavior than negative reinforcement (Cf. Bandura, 1962). However, recent experiments which take into account the previous history of the learner (e.g. Church,

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1963; Solomon, 1964; Baxter, Lerner, and Miller, 1965) demonstrate that there are individual differences in the reinforcement value of various types of stimuli. Children who have been accustomed to positively reinforced experiences do learn best when they receive approval or tangible rewards, but it is also likely (cf. Lee, 1967) that those who have known a preponderance of punishment seem to respond best to aversive stimuli. That is, they put out more effort to avoid punishment, perhaps because they have learned that the best they can expect is the avoidance of pain.

In line with such findings, a number of investigators have noted that students who come from poor families show a marked lack of interest in academic achievement and are not particularly responsive to awards or commendations usually considered to be positive reinforcement for school success. (Cf. Gordon and Wilkerson, 1966.) There is also some evidence that children from low-income homes do not put out effort for delayed rewards, nor are they as apt to work for social approval as for material or tangible reinforcement (e.g. Terrell, 1958).

In all of these investigations, however, the focus is on the motivational effects of temporal or other variables relating the nature of the reinforcer to that of the learner. Another basis for evaluating reinforcement procedures is in terms of their effectiveness in providing informative feedback. That is, does the event which follows the student's response provide a meaningful cue which can be expected to set or alter the student's subsequent responses? Suppes and Ginsberg (1962) present evidence that children do not automatically infer, in a two-choice situation, that if one response is incorrect the other is necessarily correct. Thus they found that a non-reinforced incorrect response provided minimal informational

value to the learner. With reference to the nature of the reinforcer given for the correct response, Terrell and Kennedy (1957),found that the effectiveness of response acquisition was contingent upon the type of reinforcer used. Stimbert, Frazier, Keller, and King (1968) using a commercially available program, determined the effect of three reinforcement conditions on the learning and retention of simple nouns by academically retarded children. The addition of candy reward to a novel method of presenting knowledge of results (the color change of the stimulus when marked with a special pencil) produced no change in performance when given on a continuous schedule, but reduced frequency of responding on a partial schedule, i.e. when given only on the terminal frames.

In a previous study by the authors (Stern and Teager, 1968),it was demonstrated that while young children given complete feedback were better able to transfer to new classification tasks than those given no feedback, or those given only knowledge of correct response, no differences for treatment were found on the immediate posttest over the program content. It was felt that perhaps these young children had not yet learned to work for the secondary reinforcement of "being right."

The present study is an attempt to determine conditions which influenced the child's ability to use feedback as information. Specifically, the hypotheses were stated as follows:

1. Five-year-old children can be taught to use chemical feedback as information to enable them to learn new associations.

2. Children who are given feedback accompanied by a token reinforcer (raisins) will be superior when compared to those children who are given only verbal reinforcement.

3. Children who continued to receive reinforcement in a new learning situation will exhibit greater ability to use feedback as information than those whose reinforcement is withdrawn.

METHOD

Subjects

A group of 21 black children consisting of 6 boys and 15 girls, 45 to 65 months of age, in three urban Children's Centers were given the Peabody Picture Vocabulary Test and assigned on a stratified random basis to one of the treatment groups.

Treatments

The children in all three treatments received chemical feedback. In addition, all treatment groups were given the verbal information "Green means it is the right picture and red means it is the wrong picture" each time a marking response was made during the three-day instructional program.

Treatment 1 (information only group) received only the information concerning the feedback. All children in Treatment 2 (token reinforcement group) were given a raisin [1] each time a correct marking response (green dot) was made. No raisins were given if an incorrect alternative (red dot) was selected.

The members of Treatment 3 (verbal reinforcement group) were given verbal approval each time they selected a correct response, e.g., "You're doing a good job. That's a good boy (girl)," and mild verbal criticism, e.g., "That's too bad. You're wrong," or "Oh, you marked the wrong picture," when an incorrect response was made.

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[1] Prior to the experiment, the effectiveness of raisins as reinforcers was confirmed for this population.

Materials

The chemical feedback was a special mimeograph ink developed by the A. B. Dick Company. This ink contains a water-soluble, non-toxic pigment, such that when the material is printed there is no way of distinguishing the embedded color of the feedback dot. However, when one of these dots (about one-half inch in diameter) under a picture is touched with a water-filled pen, the color is released and the dot turns either green or red, depending on whether it is the correct or incorrect response.

Instructional Program

The content of the instructional program was concerned with social studies concepts relating to the life of the Eskimo. There were fifteen vocabulary words which described the clothing, food, housing, and animals the Eskimo child might encounter. Seven vocabulary words were presented on Day 1 of the program, eight words were given on Day 2, and all 15 were reviewed on Day 3.

Procedure

The three day program was given to groups of approximately three children at a time. Dividers were used between the children so they could not see each other. The lessons took between 12 to 15 minutes each day. The experimenter and her assistant went to alternate Centers each day to attempt to avoid any bias a child might develop toward one of the participants.

Prior to the instructional program all children were given a twelve-page booklet to familiarize them with the marking procedure and the use of the water pens.

During the instructional session the examiner presented the vocabulary words with an 8 1/2 X 11 picture which portrayed an Eskimo engaged in some

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activity related to the concept. The child also marked the same vocabulary word in an 8 1/2 X 5 1/2 booklet which contained three pictures on each page; only one picture was the correct response. For example, the child was told "Here is Sayac putting on his mukluks." The picture would then be placed face down on the table and the child was told to turn to the next page in the booklet and "Mark the mukluks." After marking he was then told, "Green means it is the right picture. Red means it is the wrong picture." The children in Treatment 2 also received a raisin for a correct answer and no raisin if the answer was incorrect. Treatment 3 received verbal praise or criticism.

Criterion Measures

All testing was carried out on an individual basis. The criterion tests included a pretest over the program content. This same test was also administered as the posttest. The basic criterion was a paired associate task given as a posttest to determine the comparative effectiveness of the different reinforcement procedures in a new learning situation.

For the paired-associate task, each child was presented with a minimum of four 10-page booklets. Each of these four booklets taught a new vocabulary word related to the same content area: 1. shaman, 2. kayak, 3. cache, and 4. caribou.

In the caribou booklet, for example, the child was told "Mark the caribou," on each of the ten pages. Criterion was four successive correct responses. The subject's score on each PA task represented the number of errors he made before reaching criterion. If he selected either or both of the wrong (red dot) pictures only once before finding the correct (green dot) picture this was not considered an error. If the child knew that a red

dot indicated an incorrect picture, and tried another picture, he was correctly using that feedback as information to select the appropriate picture. If the child did not reach criterion on the first booklet, another identical 10-page booklet was given. This procedure was followed for each of the vocabulary terms.

Recognizing that some children may be affected by the withdrawal of the reinforcement, one half of the token reinforcement group (Treatment 2) and one half of the verbal reinforcement group (Treatment 3) were randomly selected to continue to receive reinforcement during the paired-associate learning. However, no children were given informative feedback.

Results

Table 1 presents means and standard deviations on the Peabody Picture Vocabulary Test as well as the criterion measures for all three treatments.

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To test the first and second hypotheses, a one-way analysis of covariance using pretest scores as the covariate, was carried out for the three treatments. Token reward was found to be significantly superior ($F = 4.50$; df 2/17; $p < .05$) to praise on the fourth and most difficult paired-associate task only. However, on this same, task, the information-only treatment had a lower mean raw error score than both reinforced groups and was significantly superior to the verbal-reinforcement group.

Because it was felt that withdrawing reinforcement during the posttest might have a confounding effect on the evaluation of the extent to which the different treatments taught the meaning of the feedback, half of each of the two

reinforced groups were randomly assigned to a group which continued to receive the reinforcement and the other half to a group which had reinforcement terminated during testing. Table 2 presents the means and standard

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deviations for these subgroups.

On the first paired associate task, the error rate was considerably higher when reinforcement was terminated than when it was continued. However, because of the small number of children in each cell, and the extremely wide range of performance, this difference was not statistically significant. By inspection of the scores on the successive paired-associate tasks, an interesting phenomenon can be observed. The group which had been given the token reinforcers continued to respond differently, that is, the half which continued to get raisins for correct responses continued to make considerably fewer errors compared to the members of the same group who no longer received the token reinforcers. On the other hand, continuing to receive verbal reinforcement seemed to produce an adverse effect. On the last paired-associate task no one in this group achieved criterion.

Hypothesis 3 cannot be fully supported. It is obvious that some children of this population were able to understand fully the meaning of the red and green chemical feedback as informative, since 12 children made no errors on the paired-associate learning tasks. For these children, the chemical feedback had become a potent instructional tool. However, four children failed to reach criterion on three of the four paired-associate tasks.

On each of these tasks, the group means varied considerably. Although the information-only treatment had a lower error rate on the third set of paired-associates, this difference was not statistically significant. No significant differences were found by comparing the three treatments on the first two paired-associate tasks nor on the total paired-associate error scores.

The test on the program content indicated that children in all treatment groups showed a significant gain in mastery over the material presented. The pretest means for each of the three groups were very close: the mean scores were 7.0, 6.0, and 6.3, respectively, and the posttest over the program content showed equivalent scores for all treatments (12.7, 12.3, and 12.7).

DISCUSSION

The purpose of this study was to get a closer look at how preschool children from disadvantaged environments view the stimuli they receive from the environment whenever they produce responses in learning situations. It is customary to assume with children from the middle class home that being "right" has a motivational effect. More and more evidence seems to indicate that this is not universally true. The question raised here is whether a primary reinforcer will serve as a bridge to establish and strengthen the effect of the secondary, verbal reinforcer. In the study reported here the data seems to indicate that the token reinforcer is certainly more potent. However, the most interesting finding is that neither of these affective types of reinforcers are necessary. Children can learn to receive feedback stimuli as information signals and continue to use them in quite different learning situations. In fact, introducing rewards, whether tangible or verbal, produces emotional side effects which can interfere with learning.

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TABLE 1

Means and Standard Deviations on Peabody Picture Vocabulary Test, Pretest, and Posttest, and Scores on Paired-Associate Tasks[a], by Treatments

Tests	N	TREATMENT GROUPS: Information Only		Token Reinforcement		Verbal Reinforcement	
		8		7		6	
		M	SD	M	SD	M	SD
Peabody Picture Vocabulary		52.6	11.0	47.3	10.0	45.3	9.4
Pretest		6.3	1.2	7.0	1.5	6.0	1.4
Posttest		12.5	1.9	12.7	2.6	12.3	1.1
Paired-Associate Task #1		4.9	6.1	4.7	6.0	6.3	7.3
Task #2		2.7	6.9	.1	.4	3.3	7.5
Task #3		6.8	6.4	10.7	10.8	12.5	10.3
Task #4		7.3	7.8	11.0	7.2	17.7	3.2
Paired-Associate Total Score		21.6	22.9	26.6	18.6	39.8	21.1

[a]All Paired-Associate scores are reported in terms of mean errors.

TABLE 2

Means and Standard Deviations for Two Treatments Receiving Reinforcement, Grouped According to Whether Reinforcement was Continued or Terminated for the Paired-Associate Task

	TREATMENT GROUPS							
	Token Reinforcement				Verbal Reinforcement			
	Continued		Terminated		Continued		Terminated	
N	4		3		3		3	
Tests	M	SD	M	SD	M	SD	M	SD
Peabody Picture Vocabulary	47.3	9.8	47.3	10.2	47.0	9.3	45.3	9.5
Pretest	6.8	1.2	7.3	1.8	6.3	1.6	5.7	1.2
Posttest	12.8	2.1	12.7	3.2	12.7	1.2	12.0	1.0
Paired-Associate Task #1	1.0	2.0	9.7	10.0	3.0	5.0	9.7	9.5
Task #2	0.3	.5	0.0	0.0	6.3	10.9	0.3	.5
Task #3	9.5	10.9	12.3	10.7	12.7	10.1	12.3	10.7
Task #4	7.5	8.7	15.7	5.9	19.0	0.0	16.3	5.5
Paired-Associate Total Score	18.3	17.3	37.7	20.5	41.0	13.7	38.7	25.3